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THE EDGE DETECTION SCHEME IN IMAGE PROCESSING USING ANT AND BEE COLONY OPTIMIZATION

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Abstract

ACO is experienced with pondering picture edge detection problems in order to advance the edge data already available in the image, which is essential to understanding the image's content. Finding good visits using the excellent input provided by the ant pheromone update is the core component of ACO. Ant colony optimisation obtains approximations of solutions to the challenging problem by utilising the food-gathering strategies used by ant social organisations. Edge detection is a key component of image processing. It mostly participates in computer vision and image analysis' pre-processing stage. It generally recognises the contour of an image and provides important details about a picture. Hence, it reduces the quantity of material that has to be processed for high-level processing tasks like object recognition and picture segmentation. The most important step in edge detection is threshold setting since it decides whether or not a valid edge map will be produced. In this study, edge detection is the purpose of ant colony optimisation, which is inspired by ant colonies (ACO).

Keywords*: Ant, Bee, Colony Optimization, Edge Detection, Image Processing*

1. INTRODUCTION

Images have a significant effect on human existence. They are a constant in our life and affect almost every aspect of who we are. Because to substantial technical advancements, image processing techniques are currently employed for industrial, commercial, medical, scientific,

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and military objectives. Considering the scope of the field of image processing, new research is continually being conducted in it to address a variety of issues. The application of soft computing techniques has had a significant positive impact on picture analysis and processing. Soft computing methods include Artificial Neural Networks, Genetic Algorithms, Fuzzy Logic, and Ant Colony Optimization (ACO). These tactics are all meant to help people make decisions and deal with uncertainty. Uncertainties in image processing include things like noise, fragmentation, and missing or incorrect information. In order to handle the Travelling Salesman Problem, the meta-heuristic technique known as ACO was initially presented in 1, 2. (TSP). The application was created utilising actual ant movements that they make to find food sources. [1] Ants leave pheromones all along their line of travel. Hence, the pheromones that ants leave behind on their path of travel control their dynamic cycle. This is compatible with their existing situation-based correspondence. Edge recognition is a crucial first step in understanding a picture. In fact, the accuracy of the edges that are detected directly affects important level processing tasks like picture division and object recognition, among others. It is a pre-processing stage in applications of image division and Computer vision, particularly in the domains of component ID and element extraction. Edges address important shape highlights in the related image by making reference to the most popular method of locating locations in a computerised image where the brilliance of the image suddenly shifts, or more formally contains discontinuities. Two recent computations, Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO), sparked by regular swarms, have made progress in this area.

Italian researchers M. created the Ant Colony Optimization programme. Based on the way ants normally communicate by leaving behind pheromones that guide other ants towards a preferred route to a food source, Dorigo et al. The pheromone trails vanish with time. Since they make up for pheromone evaporation on longer paths where it has more time to do so, shorter pathways are preferable. Due to their increased pheromone density, ants favour shorter routes. [2] Several ACO algorithms have been created [6], such as the max-min ant system and the ant colony system.

Ant colonies, which are naturally tiny and straightforward, are dispersed systems that are capable of carrying out extremely complex social organisation. This happens because they are able to do a number of difficult activities that are well beyond what a single ant is capable of

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doing on their own. The ant algorithms help in the construction of original algorithms for the development of distributed systems and optimisation. They take essential traits from genuine ants. Real-world ants' highly coordinated behaviour is based on self-organizing principles, which may be explored further to develop solutions for computer problems. Among these traits are foraging, the division of labour, brood sorting, and cooperative transportation. Stigmergy, a form of indirect communication brought on by changes in the environment, is the driving factor underlying all of these behaviours. [3]In this scenario, the foraging ants deposit some form of chemical on the ground, increasing the possibility that additional ants would follow suit.

2. REVIEW OF LITREATURE

Several edge detection techniques have been developed in the literature to extract the edges from images. A few nonlinear techniques were developed and surpassed the traditional Sobel and Canny edge detectors K. One of these techniques is the logarithmic edge detection technique. A. Panetta, 2018, even managed to improve the image's lighting.

Subsequently, coordinate logic filters were used for edge detection, which proved to be particularly successful for high-dimensional applications like noise reduction B. Solutions based on the B. G. Mertzios 2015 ACO algorithm were proposed to further improve the performance of edge detectors.

The ant colony method was used to create the perceptual network of pictures, which describes the relationship between the neighbouring image points X. Zhuang, 2015 The ant colony system was able to recover the edges but was unsuccessful in controlling the noise in the images. To improve the approach, the edge identification problem was modelled as a directed graph. The ACO approach was very marginally altered, and the results were generally positive H. Nezamabadi-pou 2016 Another ant colony system-based technique was developed with the goal of extracting edges and reducing computation times by carefully assigning the ants. [4] Even if the edges retrieved exceeded those from other methods, the algorithm's accuracy might still be considerably increased.

Also, a technique based on ant colony optimisation was created to improve the performance K of the Canny edge detector. A. Panetta, 2018 found that using this technique, the edges were

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rather smooth. In order to address the problem of broken edges and even reduce the computing burden, a novel approach based on ant colony optimisation was developed.

In 2009, fuzzy logic was used with the ACO algorithm to improve the edge detection method Y. P. Wong 2017 Our approach proved to be more efficient when compared to existing ACO edge detection techniques. The Sobel operator's performance was also improved to minimise the discontinuities in the edges using a strategy based on ACO and fuzzy derivatives. A weighted heuristics-based strategy was developed in 2013 P to produce thin edges. In Rai's technique from 2014, the heuristic function was defined and the pixels' weights and priority were assigned. A robust technique based on ACO that updated pheromones using a user-defined threshold and a heuristic function was further proposed in 2015[5]. The method demonstrated good results when there was noise present, even though it operated slower than a number of other methods published in the literature. In 2016, a method for edge identification was proposed to cope with Gaussian noise and salt-and-pepper noise. The outcomes were optimistic despite the presence of this sort of noise..

3. PROPOSED METHODOLOGY

In order to create a pheromone matrix, a 2D picture is subjected to the recommended image edge detection based on ACO. The entries in that pheromone matrix each stand for the edge's position, which affected the original image's intensity shift. The method is guided by a heuristic matrix to get at the ideal spot quickly and with the least amount of computation.

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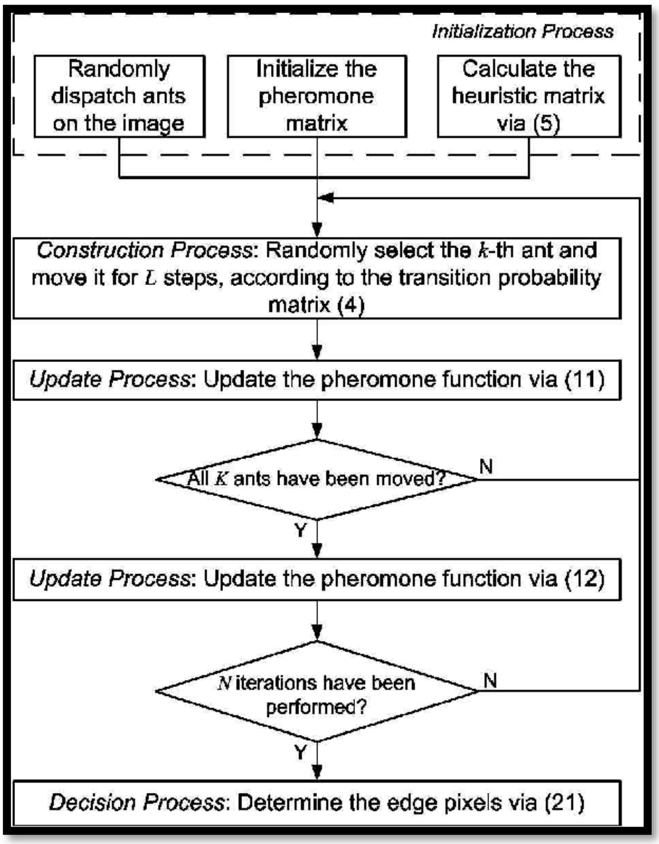

Figure 1: The proposed ACO-based image edge detection approach**.**

4. EXPERIMENTAL RESULTS

Seven test photos are used to evaluate the presentation of the suggested strategy: a tomato, a boat, a lotus sanctuary, a butterfly, a rose, birds, and the Taj Mahal. [6] These test parametric attributes are included in Table 1 and used to display the mean square error and maximum signal-to-noise ratio in Tables 2 and 3.

Figure 2: Tomato: (a) Sobel edges (b) Canny edges (c) proposed method

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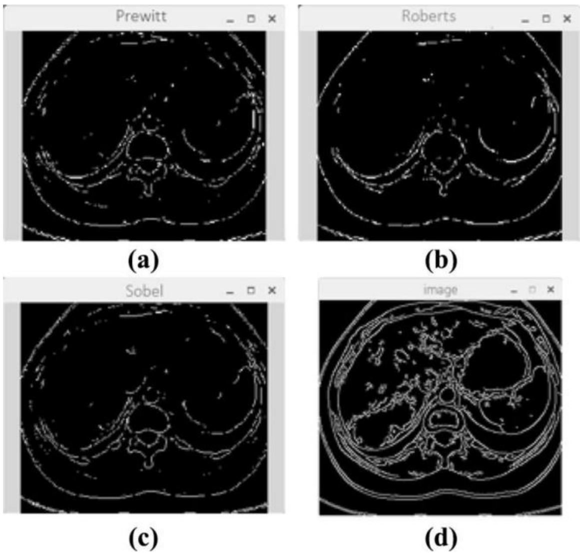

Figure 3: Ship: (a) Sobel edges (b) Canny edges (c) proposed method

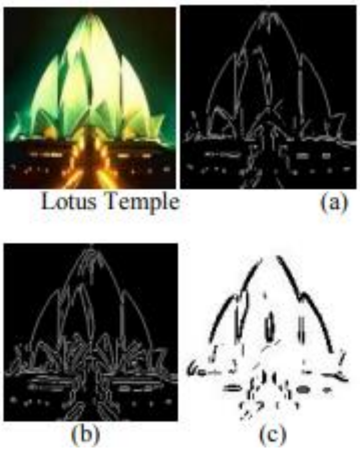

Figure 4: Lotus temple (a) Sobel edges (b) Canny edges (c) proposed method

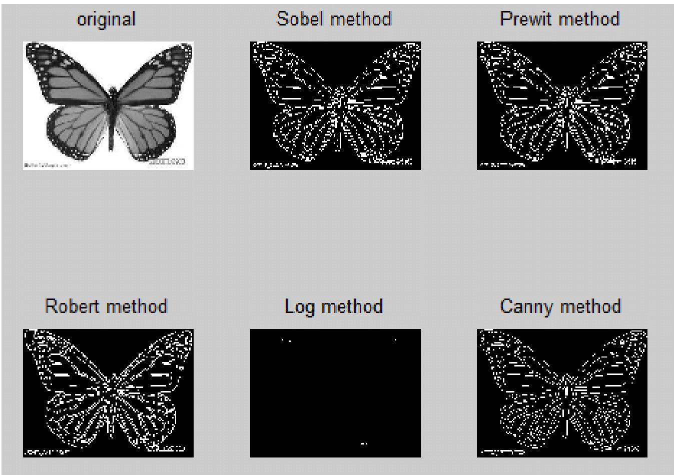

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Figure 5: Butterfly (a) Sobel edges (b) Canny edges (c) proposed method

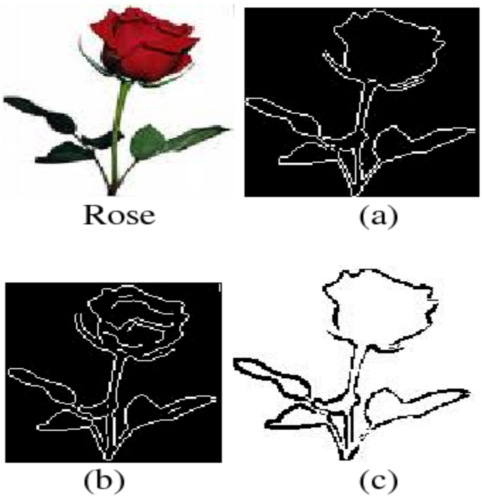

Figure 6: Rose (a) Sobel edges (b) Canny edges (c) proposed method

Image	Psnr Sobel	Psnr canny	Psnr Ant
Tomato	10.22	11.25	10.12
Ship	11.36	12.36	11.36
Lotus temple	12.45	13.22	12.11
Butterfly	15.33	13.58	14.15
Rose	16.22	14.33	16.33

Table 1: Experimental Values of Peak Signal to noise ratio

Image	Msesobel	Mse Canny	Mse ant
Tomato	11.12	21.36	21.33
Ship	14.36	15.33	14.36
Lotus temple	15.11	14.35	18.22
Butterfly	16.36	18.22	17.21
Rose	17.36	19.36	20.33

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Table 2: Experimental values of mean square error

a) Image Edge Detection

The most used method for identifying edges in digital pictures is image edge detection. It is a collection of techniques specifically designed to locate areas in a picture where abrupt discontinuities or changes in force occur. We can understand the crucial elements in the inquiry of image examination and machine vision by using these methods to grasp an image's content and the edge focuses that are recovered from an image. It serves as a pre-processing stage for element extraction and object acknowledgment. It is frequently applied in the early stages of Computer vision applications. [7] Sharp differences in image force must be kept in order to maintain major events and changes in the real qualities of the world. According to common assumptions about the process of the picture age, the sources of power variants usually compare to two types of occasions: mathematical occasions and no mathematical occasions. Examples of mathematical events include surface direction discontinuities, profundity discontinuities, and variety and surface discontinuities. Examples of non-mathematical occurrences include variations in light, shadows, and antireflective surfaces. Because each job arrangement is carried out for each pixel, traditional edge detection methods like the SOBEL administrator for Prewitt, Robert's administrator The computational cost of LoG administrator and Shrewd administrator is high.

In everyday situations, the calculating time quickly increases as the picture size does. Yet, the majority of the detection methods in use today use a wide search region for picture edge detection. [8] As a result, without optimisation, the edge detection activity uses a lot of memory and takes up the majority of the day. An ACO component course may be able to overcome the limitations of conventional approaches.

b) Ant Colony Optimization

An optimisation computation called ant colony optimisation gets its inspiration from how ant social organisations behave when they are out obtaining food. Individual ants are simple, uneducated creatures. According to certain researchers, given the current state of affairs, ants' visual tangible frameworks are often rudimentary and, in other situations, they are completely

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blind. The ants communicate through a particle called pheromone. Throughout its motions, an ant produces a dependable pheromone that other ants can recognise and follow. Each ant begins its journey in a very careless manner, but when it comes across a pheromone trail, it must decide whether to follow it or not. The ant's own pheromone strengthens the current path, assuming it followed it, and the increase in pheromone increases the likelihood that the subsequent ant would choose the same path. [9] As a consequence, a roadway becomes more enticing to resulting ants the more ants have travelled down it. Also, if an ant takes a direct route to a food source, it will check its route twice before other ants arrive since it will return to the colony first. This obviously affects the likelihood that the next ant to leave the house will be chosen. With time, more ants will be prepared to follow the more constrained route. [10]Pheromone therefore grows more quickly on shorter routes, whereas longer routes are more exposed and eventually deserted. Pheromone concentrations remain high on narrower channels because pheromone is released more quickly. When seeking food, ants often follow pheromone trails more intently. Those who are in search of food set down these trails to direct others to comparable food sources. Pheromone fixation is stronger in areas that are sometimes visited because of the distance travelled by ants to go to food sources and return to their nest. [11]Due to this tactic of encouraging feedback, the ants consistently start to accept the less lofty pathways. The ACO meta-heurist was created as a result of this common occurrence.

5. CONCLUSION

The successful acquisition and examination of ACS-based ACO-based image edge detection computation. [12] According to the results of exploratory research, the approach has the ability to detect edges in pictures. A 2-5% increase in the Pinnacle sign to scream percentage of the proposed calculation compared to the Sobel and Shrewd calculation results from the suggested calculation's mean square error being 6% to 19% lower than that of the Sobel and Vigilant calculation. The formula correctly identified the edges with the appropriate boundary values in the test photos. [13] It should be noted that the appropriate border values depend on the concept of the picture and may thus change depending on the application. In recent tests, emphasis has been placed on procedures that might improve ACS execution. Because each ant has a different level of pheromone reactivity, some are more sensitive to pheromones than others.

6. FUTURE SCOPE

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The suggested work in this thesis significantly enhanced edge recognition and medical picture segmentation, as shown by the in-depth result analysis. [14] Yet, further expansion is still conceivable. Using met heuristic methods for image reduction and enhancement, which are essential in the field of image processing, would be interesting in order to utilise the potential of met heuristic approaches for video segmentation, surveillance videos/pictures, satellite images, etc. [15]. [15] The described approaches may also be extended to encompass three-dimensional pictures that are corrupted by different types of noise.

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